Stoller
Hanford Office

DOE-EM/GJ613-2004

C4191
Log Data Report

Borehole Information:

Borehole: C4191			Site: 216-B-26 Trench		
Coordinates (WA St Plane)		GWL[1] (ft) : 331.1		GWL Date: 01/20/04	
North	East	Drill Date	Ground Level Elevation	Total Depth (ft)	Type
Not available	Not available	02/04	Not available	341	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded steel	1.2	8 11/16	7 5/8	17/32	+1.2	341
Unknown	0.5	11 13/16	10 5/16	3/4	+0.5	70

Borehole Notes:

The logging engineer measured the casing stickup using a steel tape. A caliper was used to measure the outside casing diameters. The caliper and inside casing diameters were measured using a steel tape. Measurements are rounded to the nearest 1/16 inch. The Fluor Hanford drilling supervisor provided the casing depth. Ground level elevation was not available. Logging data acquisition is referenced to the ground surface.

Spectral Gamma Logging System (SGLS) Equipment Information:

Logging System:	Gamma 2A		Type:	SGLS (35%) SN: 34TP20893A
Calibration Date:	01/04	Calibration Reference:	GJO-2004-593-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Logging System:	Gamma 1E		Type:	SGLS (70%) SN: 34TP40587A
Calibration Date:	01/04	Calibration Reference:	GJO-2004-568-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

High Rate Logging System (HRLS) Equipment Information:

Logging System:	Gamma 1C		Type:	HRLS SN: 39-A314
Calibration Date:	04/03	Calibration Reference:	GJO-2003-429-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Neutron Moisture Logging System (NMLS) Equipment Information:

Logging System:	Gamma 2F	**Type:**	NMLS SN: H380932510
Calibration Date:	09/03	**Calibration Reference:**	GJO-2003-520-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	**1**	**2**	**3**	**4 Repeat**	**9**
Date	01/20/04	01/21/04	01/22/04	01/22/04	02/18/04
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	155.0	341.0	242.0	155.0	0.0
Finish Depth (ft)	69.0	241.0	156.0	128.0	73.0
Count Time (sec)	200	200	200	200	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
ft/min	N/A[2]	N/A	N/A	N/A	N/A
Pre-Verification	BA229CAB	BA300CAB	BA301CAB	BA301CAB	AE087CAB
Start File	BA229000	BA300000	BA301000	BA301087	AE087000
Finish File	BA229086	BA300100	BA301086	BA301114	AE087073
Post-Verification	BA229CAA	BA300CAA	BA301CAA	BA301CAA	AE087CAA
Depth Return Error (in.)	0	+2	N/A	+1	N/A
Comments	No fine-gain adjustment.	Fine-gain adjustment after file -007.	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.

Log Run	**10 Repeat**				
Date	02/18/04				
Logging Engineer	Spatz				
Start Depth (ft)	65.0				
Finish Depth (ft)	72.0				
Count Time (sec)	100				
Live/Real	R				
Shield (Y/N)	N				
MSA Interval (ft)	1.0				
ft/min	N/A				
Pre-Verification	AE087CAB				
Start File	AE087074				
Finish File	AE087081				
Post-Verification	AE087CAA				
Depth Return Error (in.)	-1				
Comments	No fine-gain adjustment.				

High Rate Logging System (HRLS) Log Run Information:

Log Run	**11**	**12 Repeat**	**13**	**14 Repeat**	
Date	02/18/04	02/18/04	02/18/04	02/18/04	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	8.0	15.0	12.0	12.0	
Finish Depth (ft)	20.0	16.0	13.0	13.0	
Count Time (sec)	300	300	300	300	
Live/Real	R	R	R	R	

Log Run	11	12 Repeat	13	14 Repeat	
Shield (Y/N)	N	N	internal	internal	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
ft/min	N/A	N/A	N/A	N/A	
Pre-Verification	AC088CAB	AC088CAB	AC088CAB	AC088CAB	
Start File	AC088000	AC088013	AC088015	AC088017	
Finish File	AC088012	AC088014	AC088016	AC088018	
Post-Verification	AC088CAA	AC088CAA	AC088CAA	AC088CAA	
Depth Return Error (in.)	N/A	N/A	N/A	N/A	
Comments	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	5	6	7	8 Repeat	
Date	01/23/04	01/23/04	01/23/04	01/23/04	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	69.0	181.0	293.0	128.0	
Finish Depth (ft)	182.0	294.0	329.0	155.0	
Count Time (sec)	N/A	N/A	N/A	N/A	
Live/Real	N/A	N/A	N/A	N/A	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.25	0.25	0.25	0.25	
ft/min	1	1	1	1	
Pre-Verification	BF141CAB	BF141CAB	BF141CAB	BF141CAB	
Start File	BF141000	BF141453	BF142000	BF142145	
Finish File	BF141452	BF141905	BF142144	BF142253	
Post-Verification	BF142CAA	BF142CAA	BF142CAA	BF142CAA	
Depth Return Error (in.)	N/A	N/A	N/A	+3	
Comments	None	None	None	None	

Logging Operation Notes:

Logging was performed in this borehole on January 20-22, 2003, and February 18, 2004. Fourteen log runs were performed with four separate logging systems. These systems are referred to as SGLS 2A (4 log runs), SGLS 1E (2), NMLS 2F (4), and HRLS 1C (4). Measurements were acquired with each system except the HRLS in a single casing string (8-in.) from approximately 70 ft to total depth of the borehole. The 8-in. casing was removed from the borehole and logging was conducted with each system except for the NMLS from 0 to 70 ft in the remaining 11-in. casing. Logging was conducted with a centralizer on each sonde. Measurements are referenced to ground surface. Repeat sections were collected in this borehole for all systems to evaluate the logging system's performance.

Analysis Notes:

Analyst:	Henwood	Date:	03/18/04	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for the logging systems were performed before and after data acquisition. Acceptance criteria were met for all systems except for the post verification file number BA300CAA (log run 2 for the SGLS). The count rate for the 2615-keV energy peak was low relative to the acceptance criteria. This discrepancy suggests log data acquired during this log run may underestimate the count rate of the higher energy peaks (e.g., greater than approximately 1800 keV). The only radionuclide of interest measured above 1800-keV energy level is the 2615-keV energy peak used to determine the naturally occurring ^{232}Th concentration.

A casing correction for 0.5-in.-thick casing (8-in. casing) was applied to the spectral log data (SGLS) from 69 to 341 ft. From 0 to 69 ft, a correction for 0.75-in.-thick casing (11-in. casing) was applied to the SGLS and HRLS data. Meaningful moisture data cannot be collected in an 11-in. borehole. Consequently, moisture data were not acquired in the upper 70 ft of the borehole.

SGLS and HRLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL worksheet templates identified as G1EJan04.xls and G2AFeb04.xls for the two SGLSs and G1CApr03.xls for the HRLS using efficiency functions and corrections for casing, water, and dead time as determined from annual calibrations. Dead time corrections are applied where dead times exceed 10.5 percent. Where SGLS dead time exceeds 40 percent, HRLS data are substituted. Correction for water was used below 331 ft in depth.

NMLS data were also processed in batch mode and volumetric moisture was calculated in an EXCEL worksheet using calibration data.

Log Plot Notes:

Separate log plots are provided for the man-made radionuclides (^{137}Cs and ^{60}Co) detected in the borehole, naturally occurring radionuclides (^{40}K, ^{238}U, ^{232}Th [KUT]), a combination of man-made, KUT, and moisture, and total gamma plotted with dead time. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, casing corrections, or water corrections. Neutron moisture log plots are provided that present volumetric percent moisture content for data acquired in the 8-in. casing from 70 to 341 ft. Repeat log sections are also included where appropriate.

Results and Interpretations:

^{137}Cs was detected in this borehole between the ground surface and 75 ft. The maximum concentration was measured at approximately 3.5 million pCi/g at 13 ft in depth. ^{60}Co was detected at sporadic locations between 80 and 137 ft. The ^{60}Co concentrations are less than 0.2 pCi/g; the MDL for ^{60}Co is approximately 0.1 pCi/g.

The naturally occurring ^{238}U exhibits a relatively higher concentration between 0 and 70 ft (log run 9) than in the remainder of the borehole. This higher concentration is probably the result of enhanced radon.

The repeat sections for the SGLS and NMLS indicate good agreement.

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[1] GWL – groundwater level
[2] N/A – not applicable

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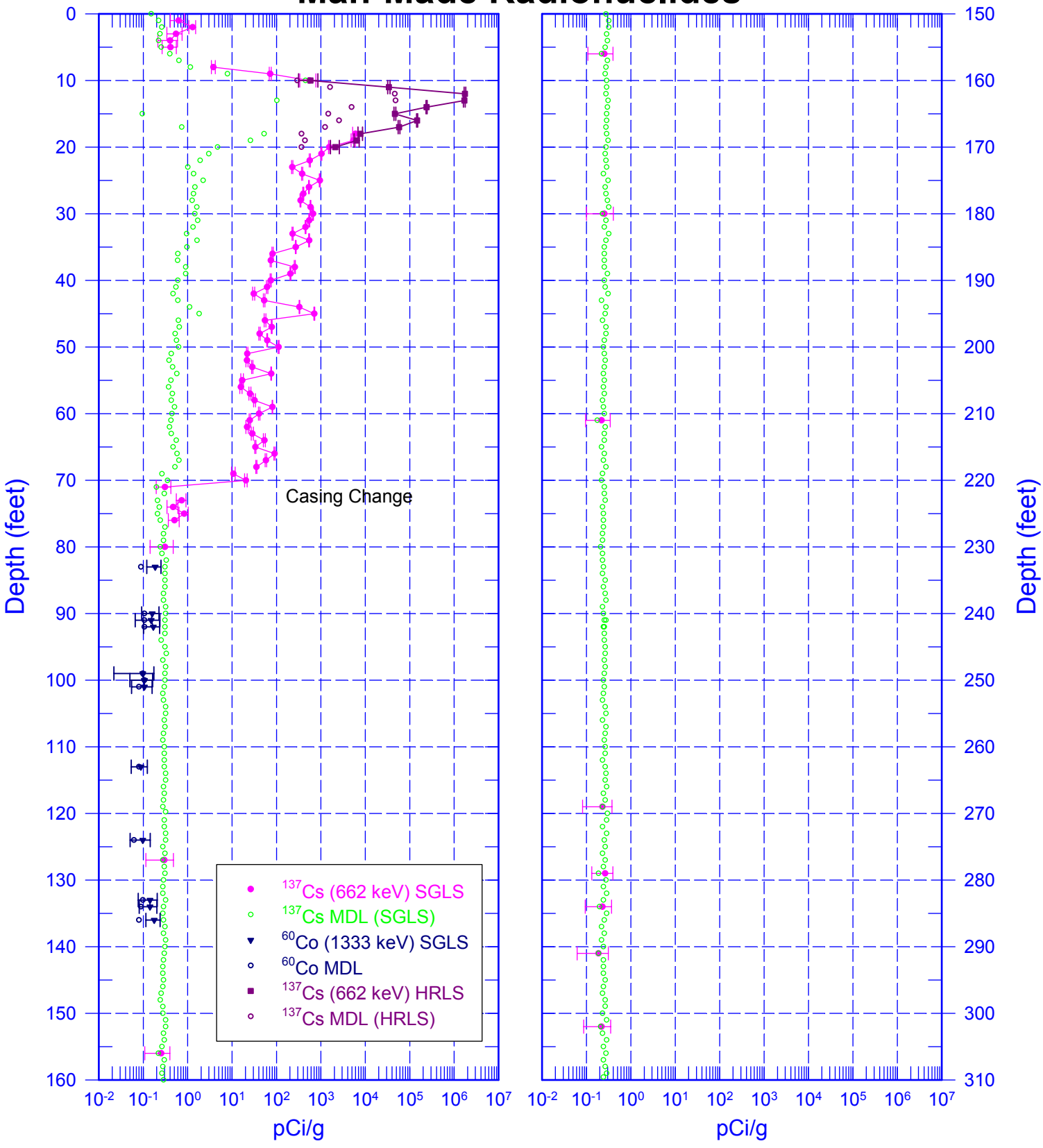
Man-Made Radionuclides



Zero Reference = Ground Surface

Depth Scale: 1"=20 ft

Last Log Date - 02/18/04

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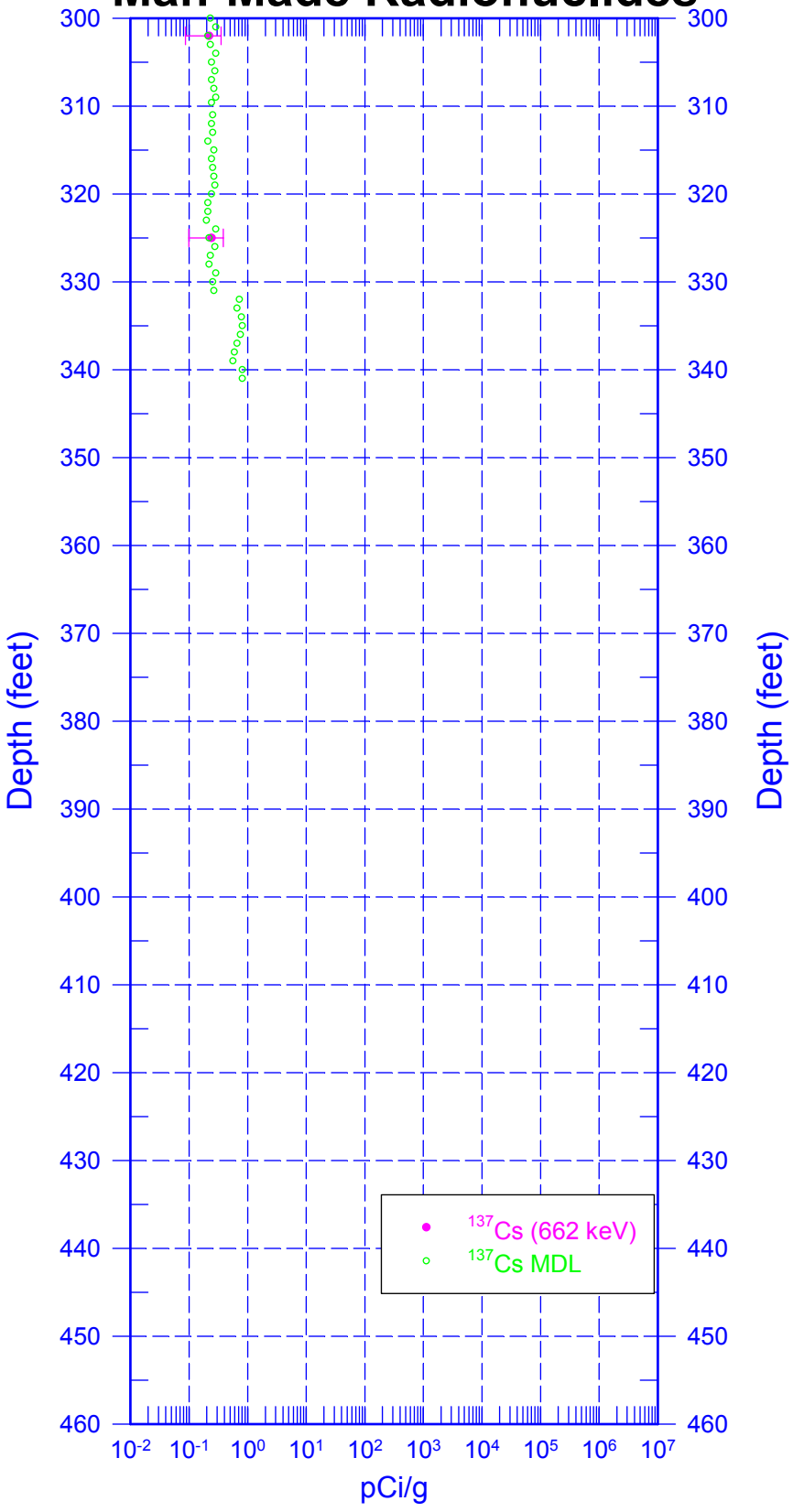
Man-Made Radionuclides



Zero Reference = Ground Surface

Depth scale: 1"=20 ft

Last Log Date - 02/18/04

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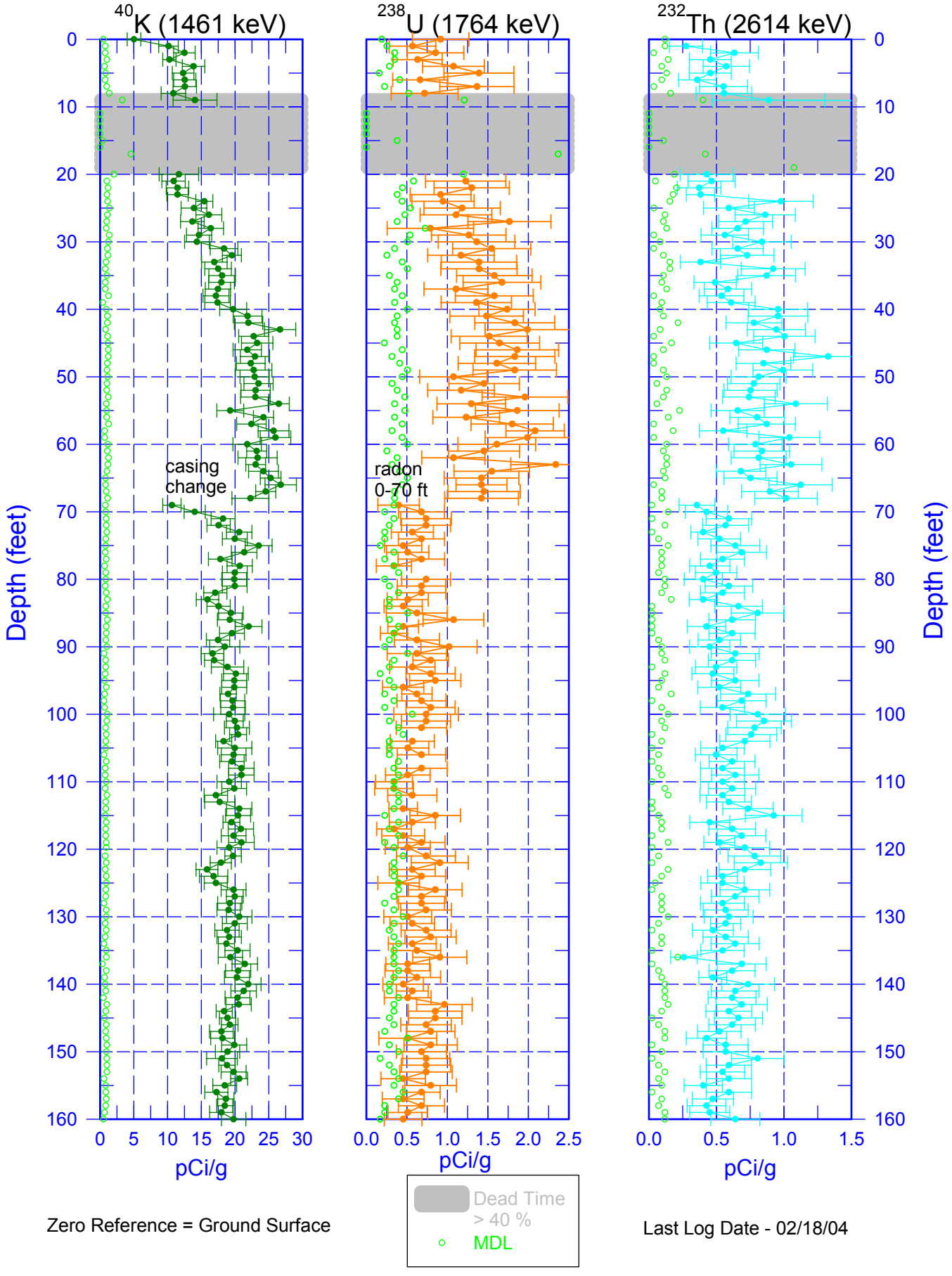
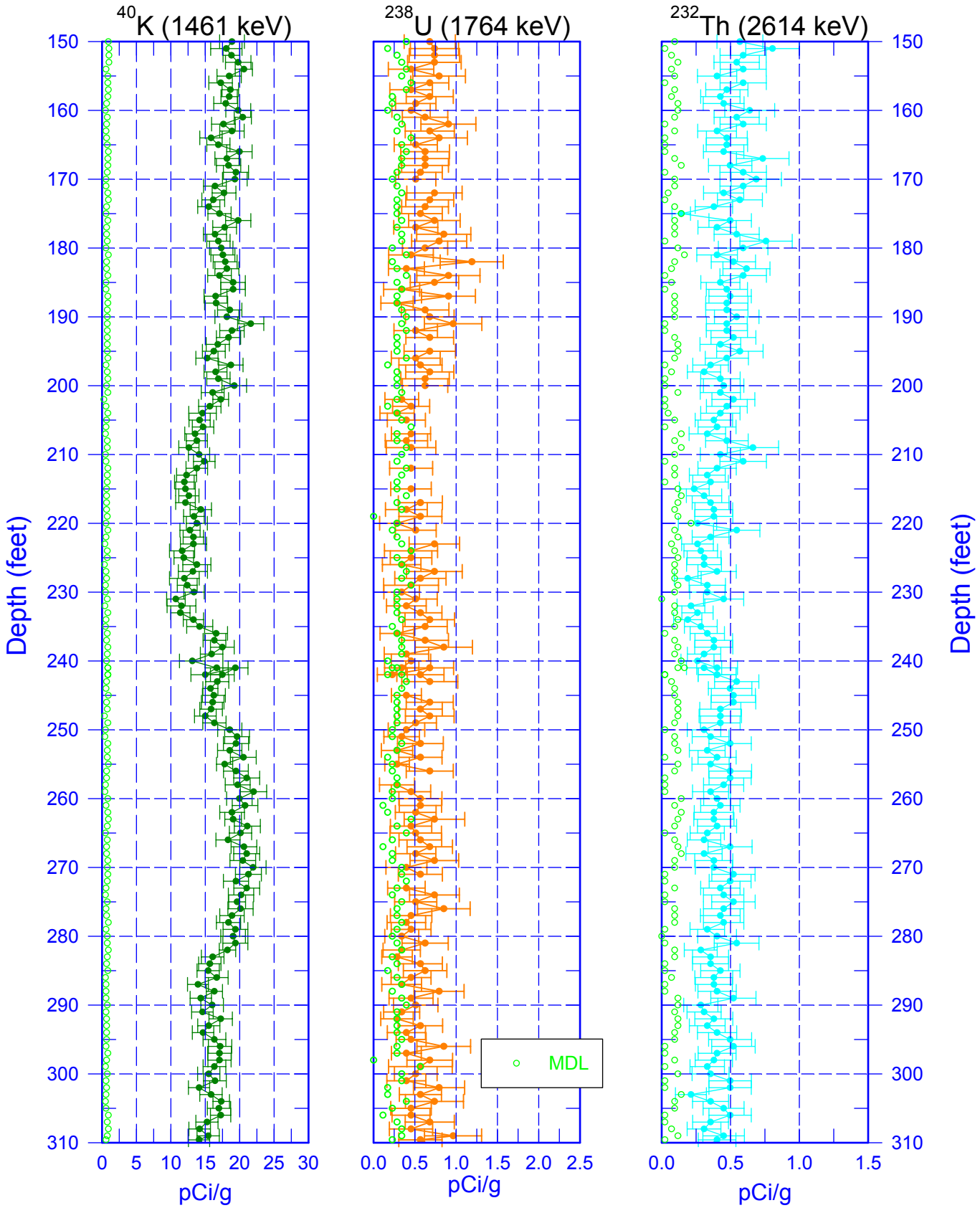
Natural Gamma Logs



Zero Reference = Ground Surface

Last Log Date - 02/18/04

C4191
Natural Gamma Logs

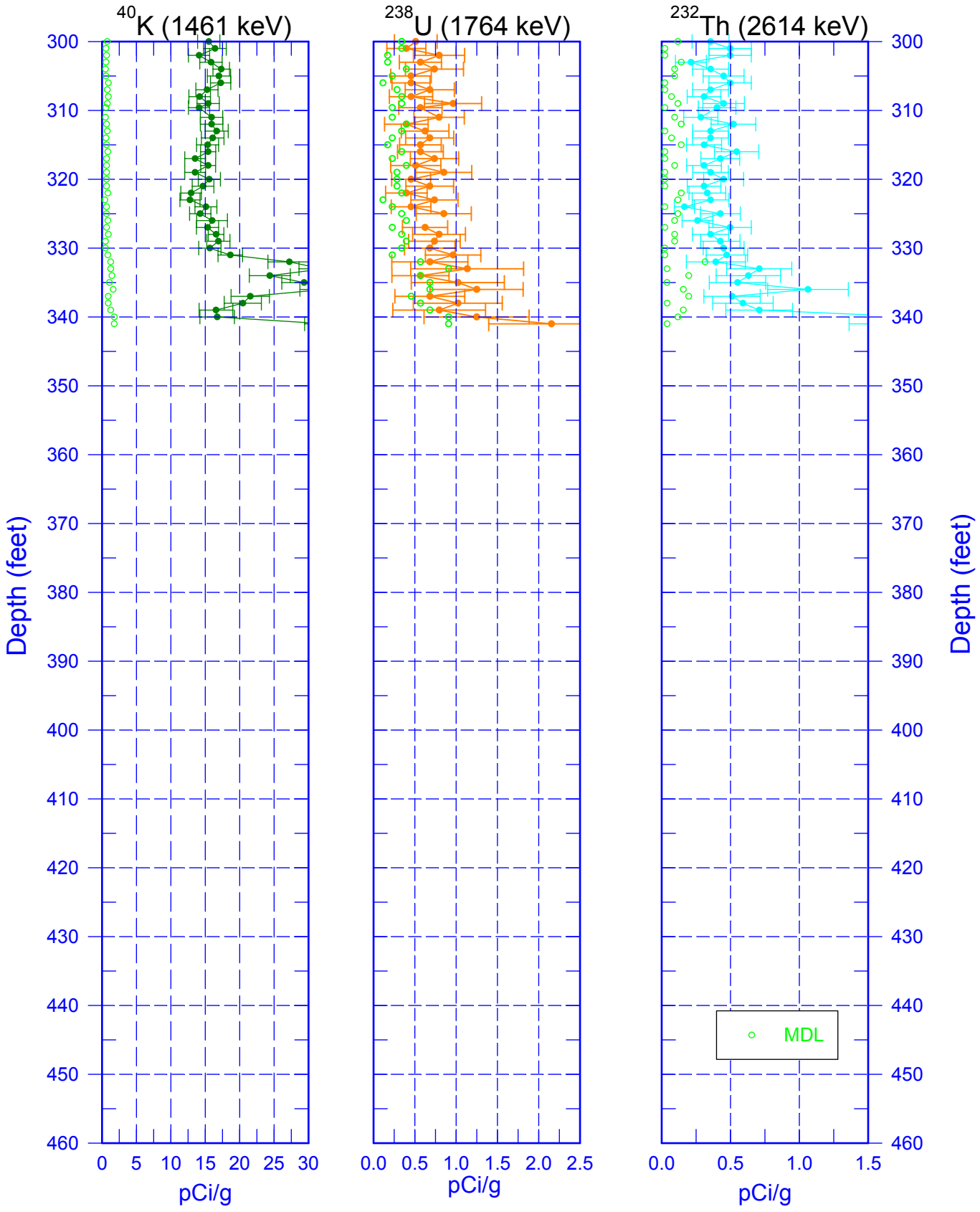


Zero Reference = Ground Surface

Depth scale: 1"=20 ft

Last Log Date - 02/18/04

C4191
Natural Gamma Logs

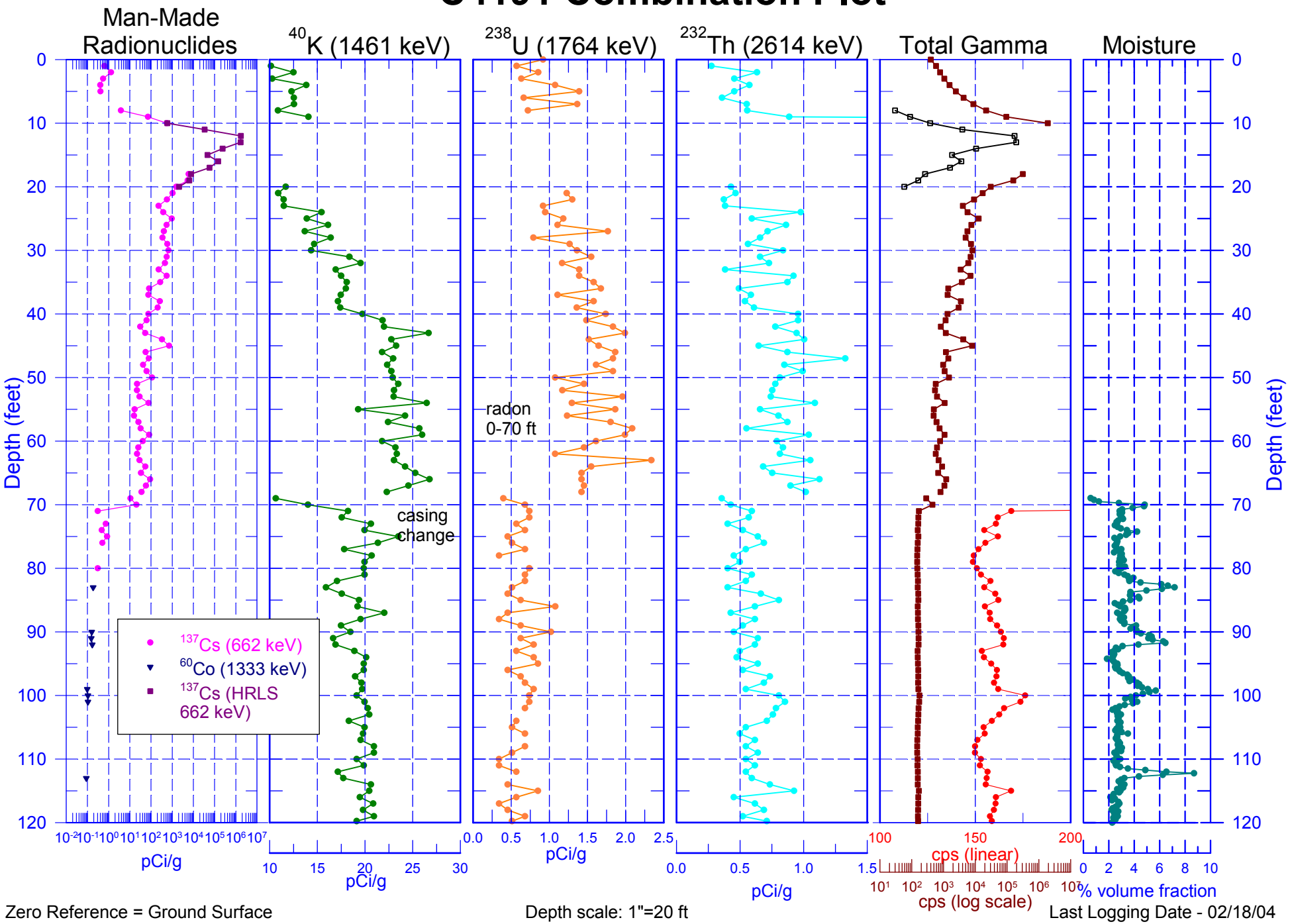


Zero Reference = Ground Surface

Depth scale: 1"=20 ft

Last Log Date - 02/18/04

C4191 Combination Plot

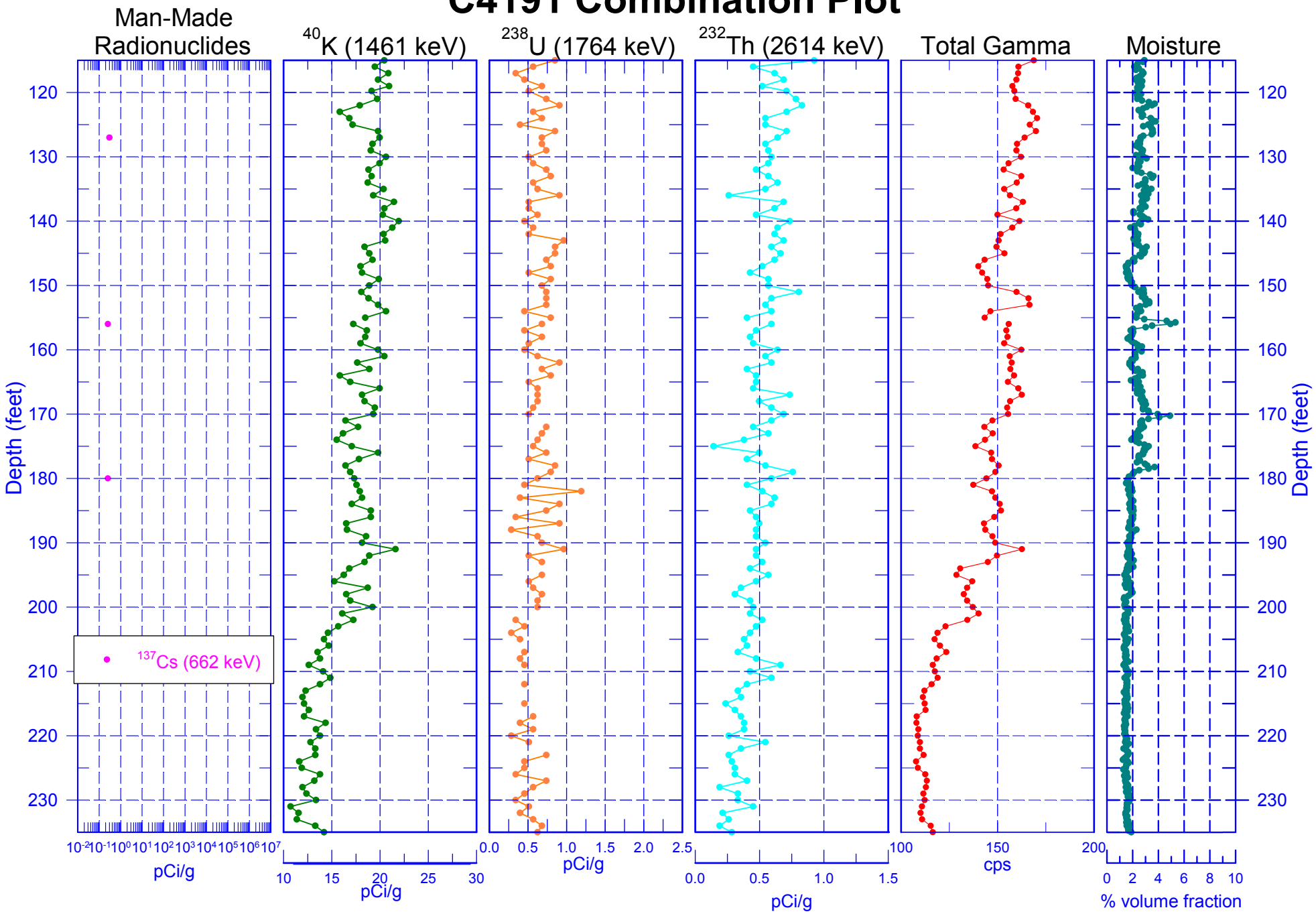


Zero Reference = Ground Surface

Depth scale: 1"=20 ft

Last Logging Date - 02/18/04

C4191 Combination Plot

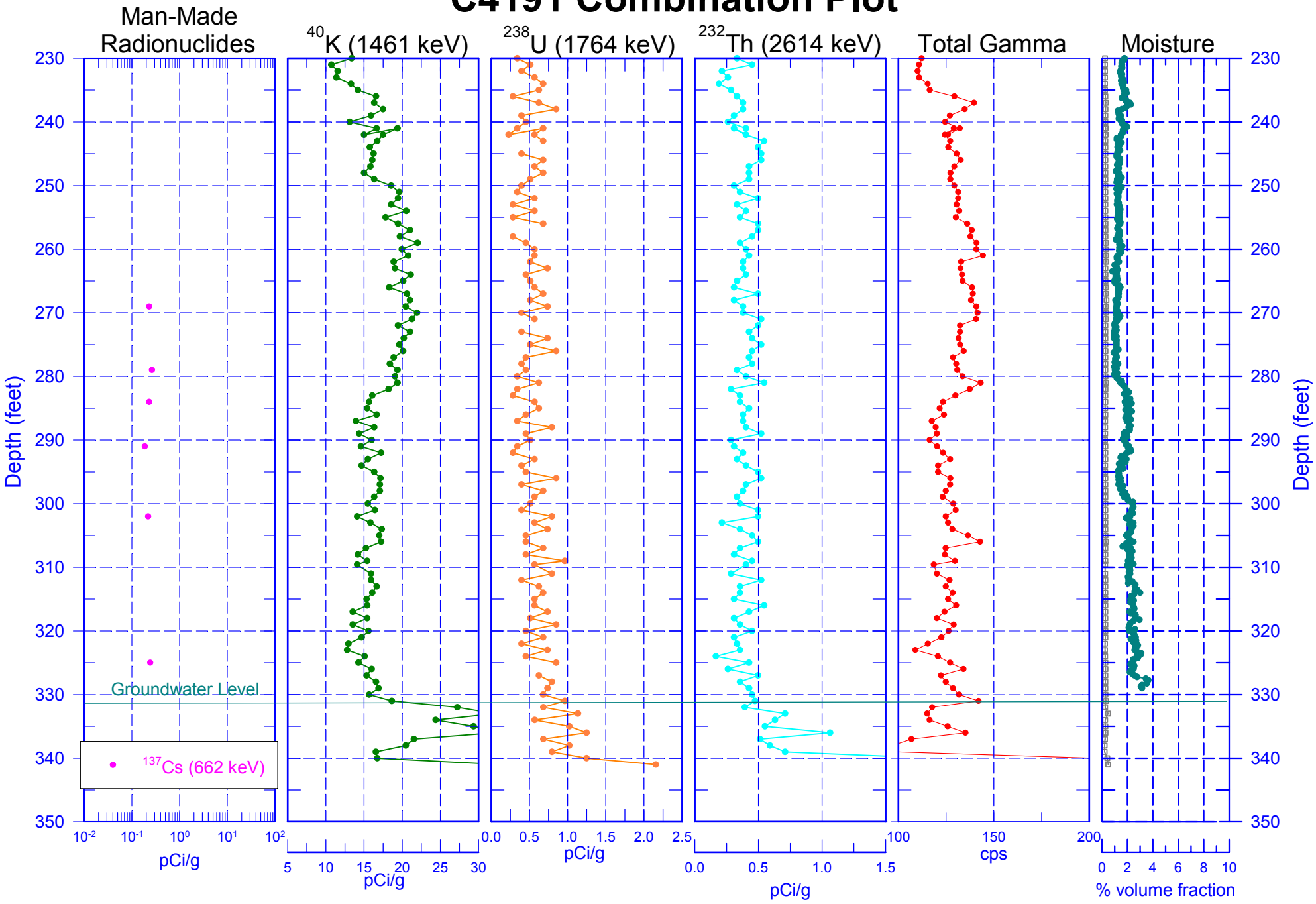


Zero Reference = Ground Surface

Depth scale: 1"=20 ft

Last Logging Date - 02/18/04

C4191 Combination Plot



Zero Reference = Ground Surface

Depth scale: 1"=20 ft

Last Logging Date - 02/18/04

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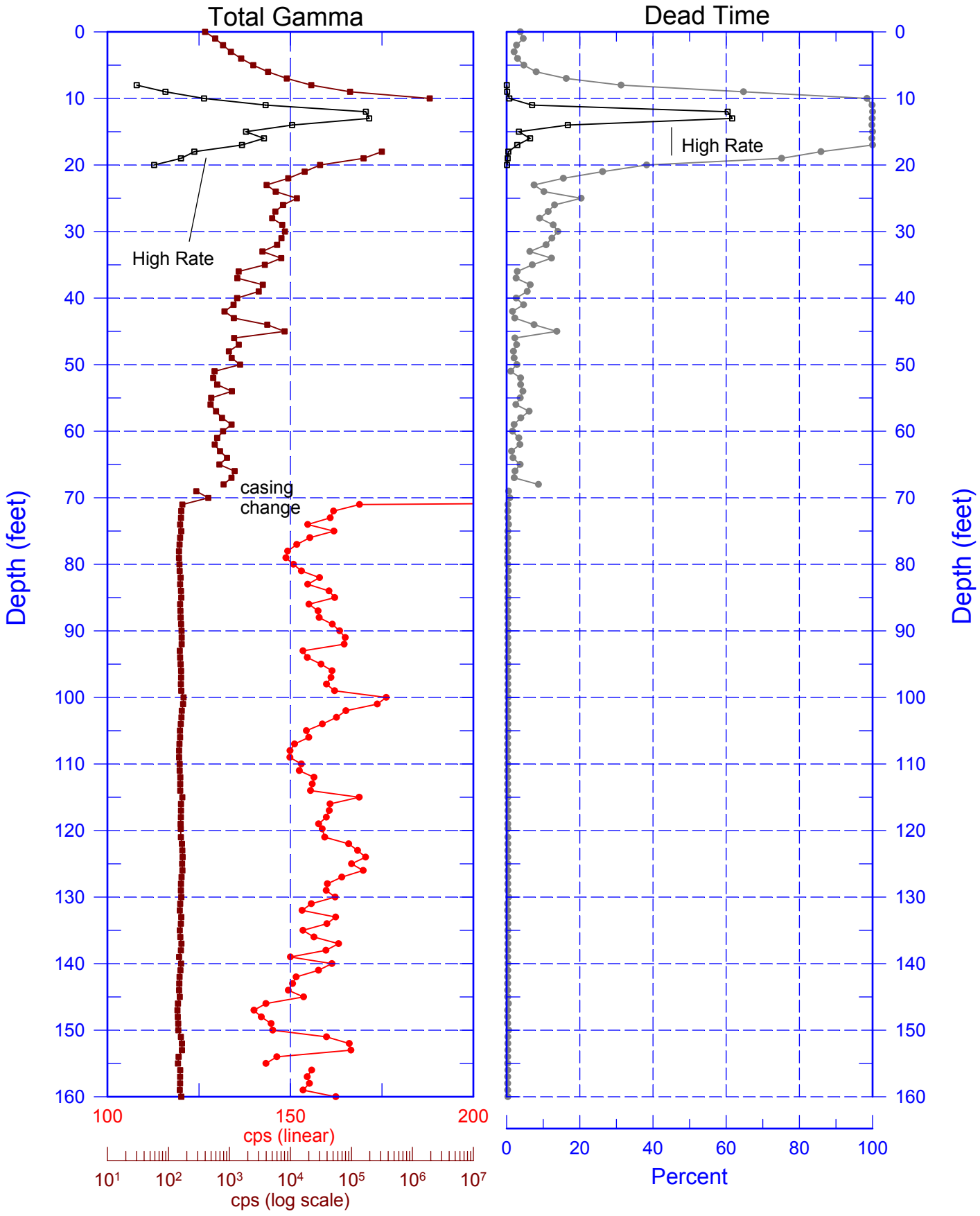
Total Gamma & Dead Time

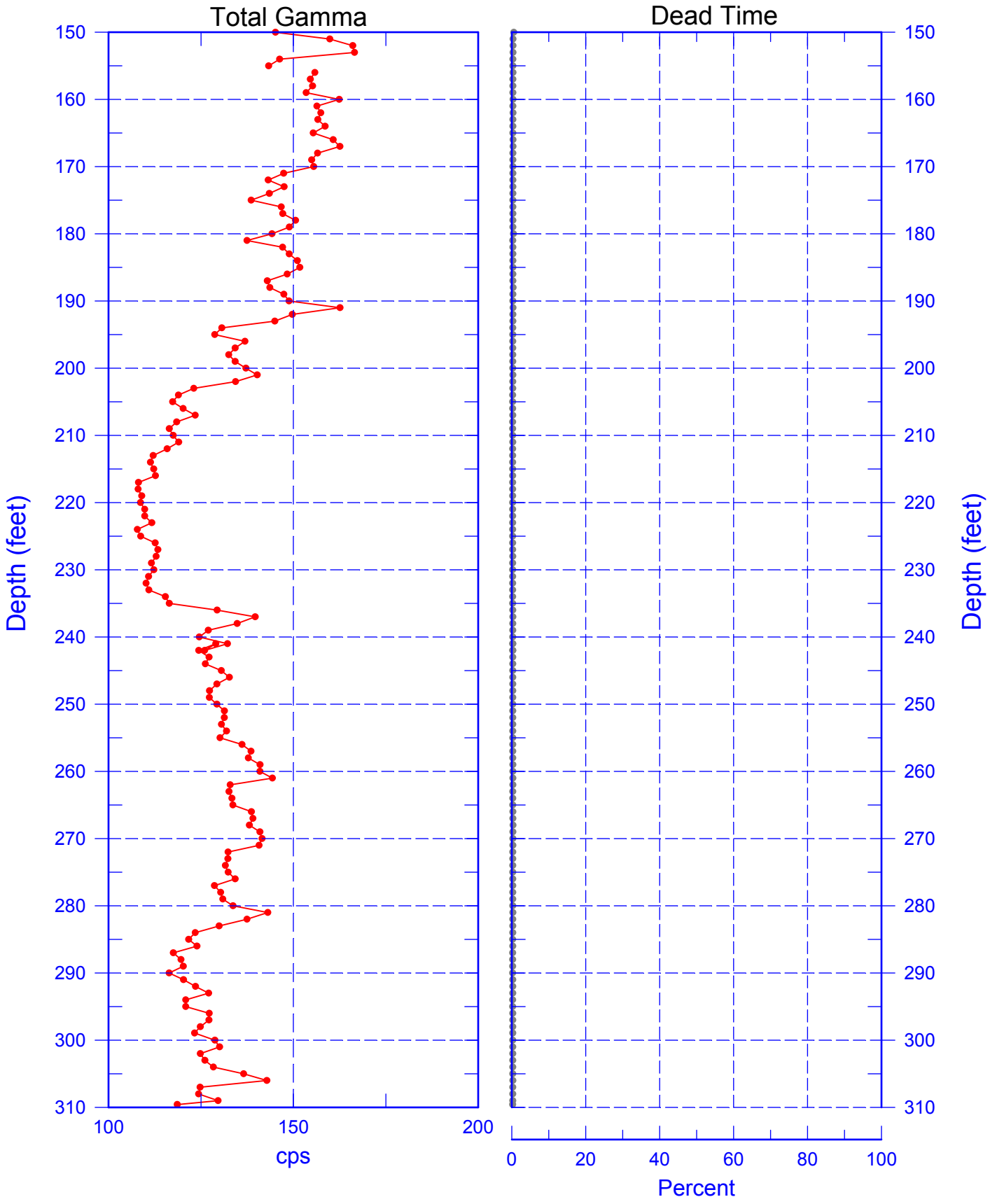


Depth scale:1"=20 ft

Reference - Ground Surface

Last Log Date - 02/18/04

C4191
Total Gamma & Dead Time

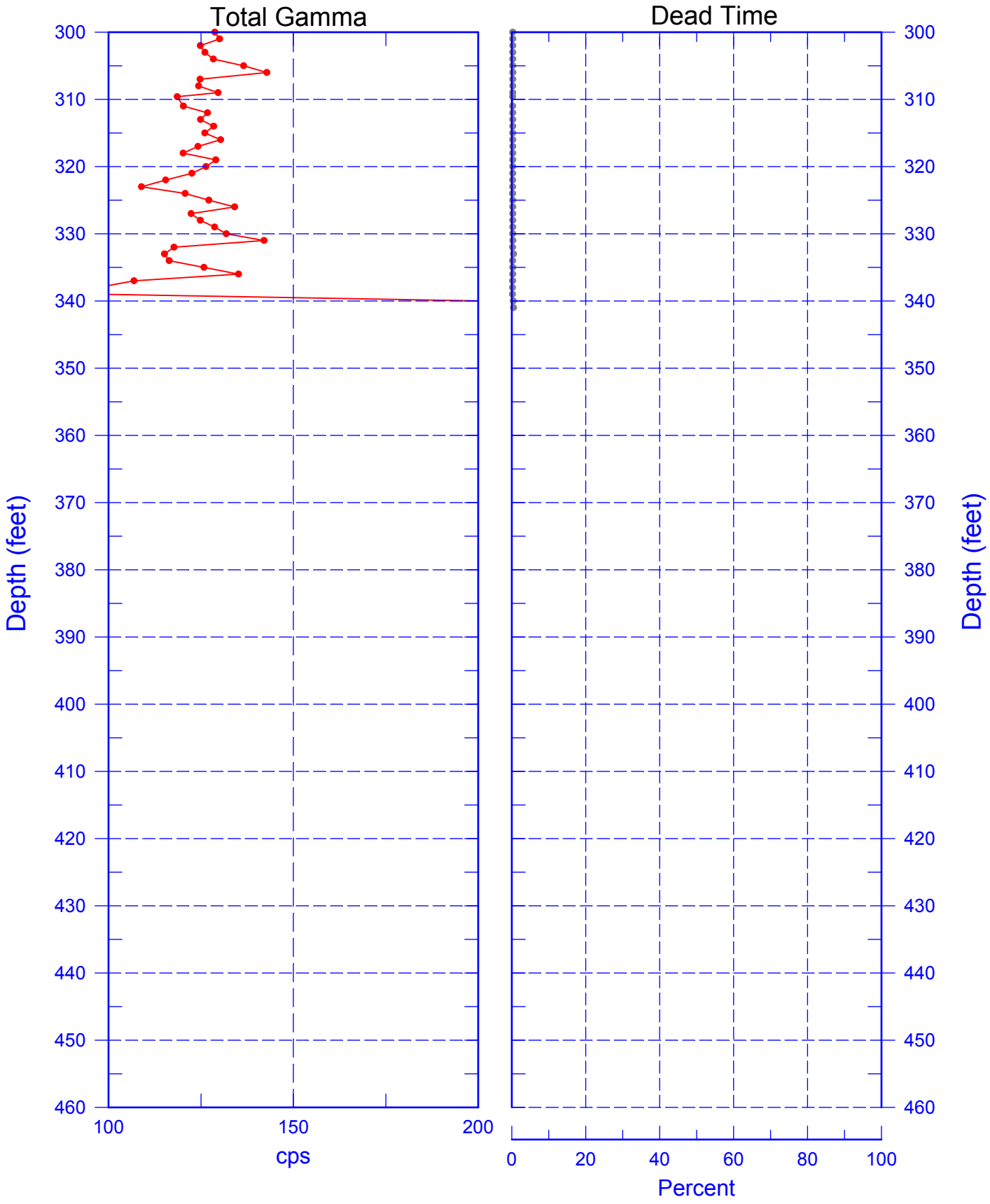


Reference - Ground Surface

Depth scale: 1"=20 ft

Last Log Date - 02/18/04

C4191
Total Gamma & Dead Time

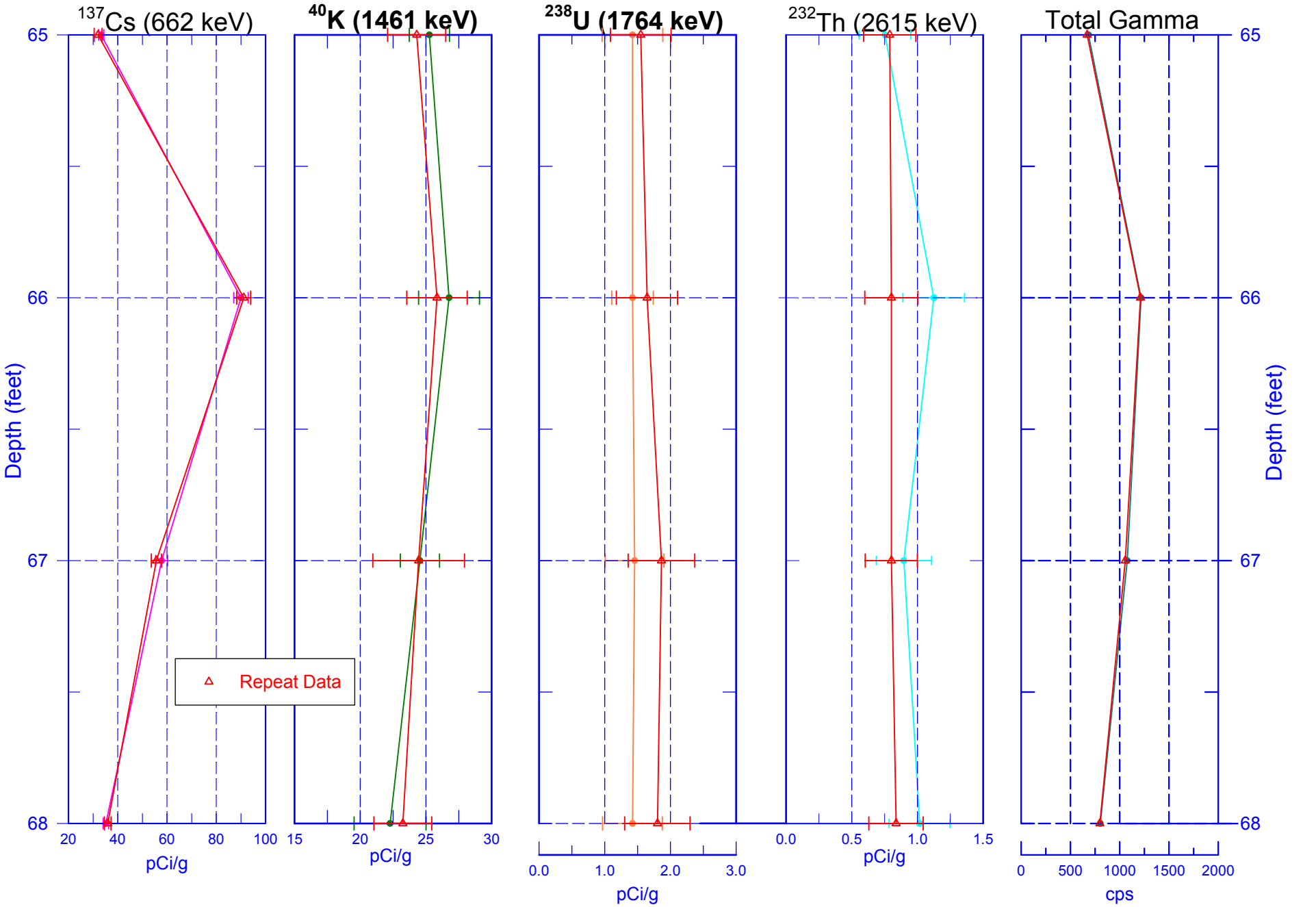


Reference - Ground Surface

Depth scale: 1"=20 ft

Last Log Date - 02/18/04

C4191 Repeat Section



Zero Reference = Ground Surface

Last Logging Date - 02/18/04

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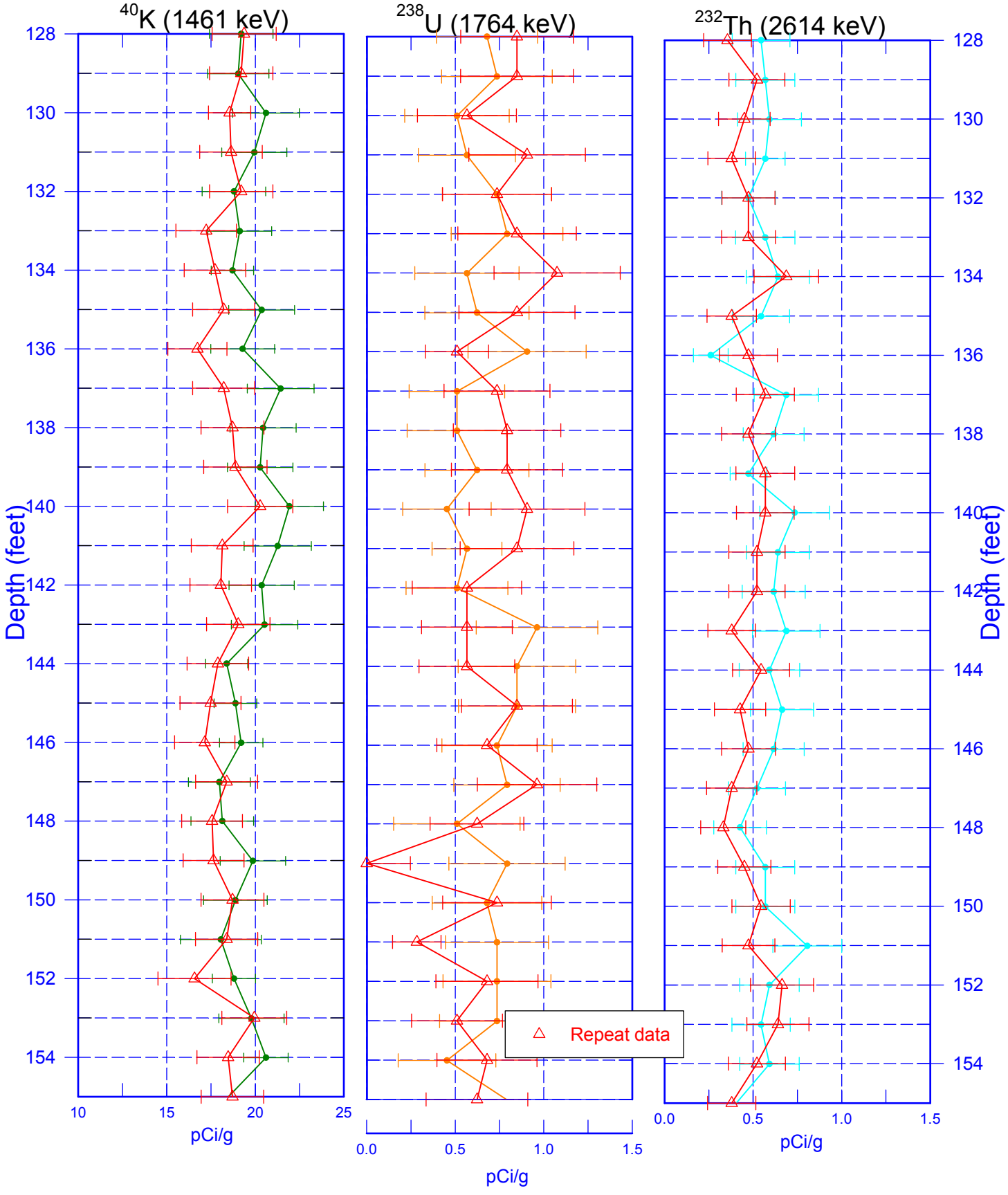
Repeat Section of Natural Gamma Logs



Zero Reference = Ground Surface

Last Log Date - 02/18/04

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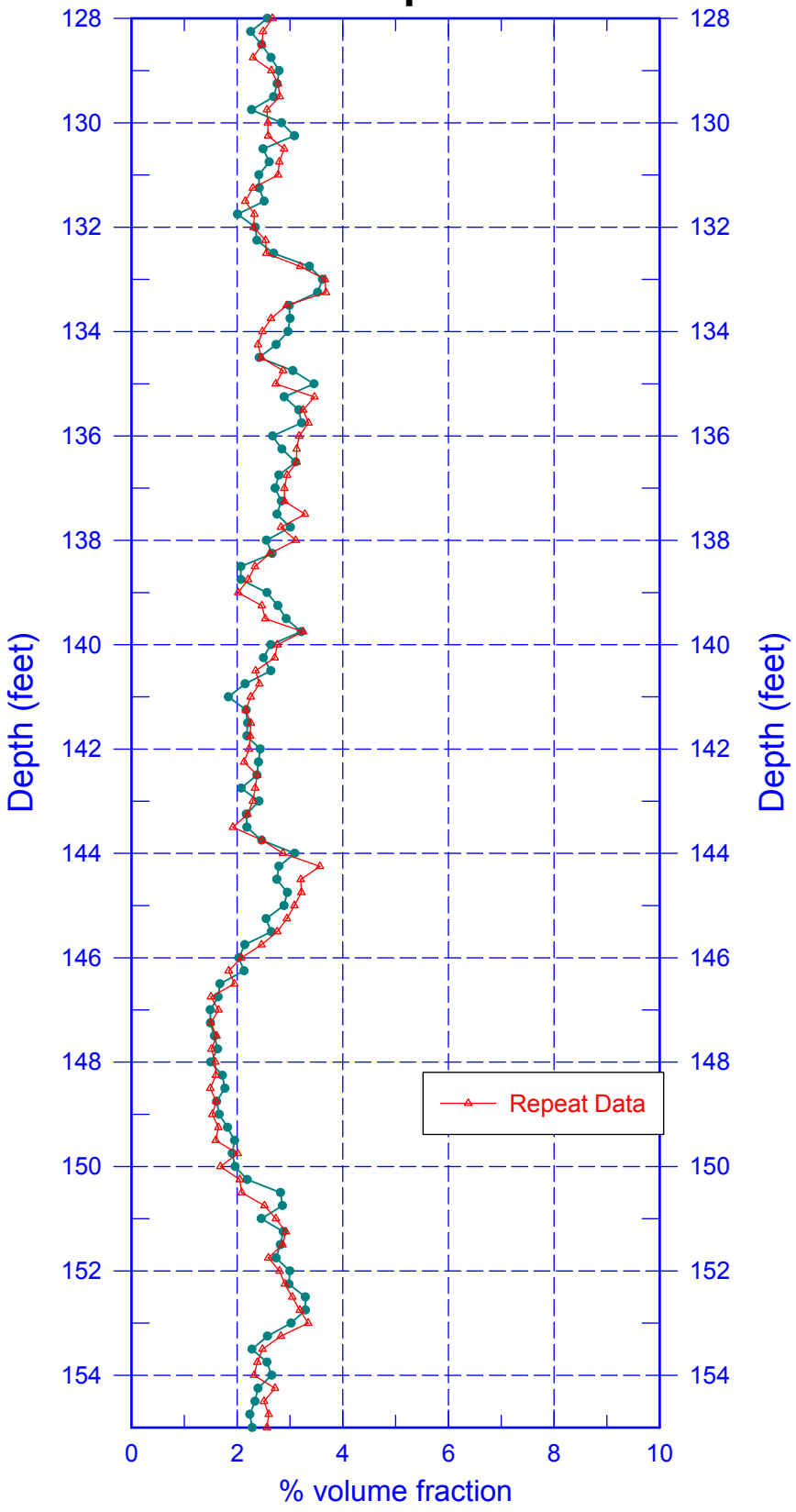
Moisture Repeat Section



Zero Reference = Ground Surface

Depth scale: 1"=20 ft

Last Log Date - 02/18/04